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EXAMINER

ARANCIBIA, MAUREEN GRAMAGLIA

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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/784,697
Filing Date: February 23, 2004
Appellant(s): MARTIN ET AL.

Scott A. Horstemeyer
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 15 December 2006 and 6 March 2007
appealing from the Office action mailed 1 August 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

4,950,376	Hayashi et al.	08-1990
5,279,669	Lee	01-1994
6,231,777	Kofuji et al.	05-2001

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1, 2, 4-7, 9-11 and 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 4,950,376 to Hayashi et al. in view of U.S. Patent 5,279,669 to Lee.

Hayashi et al. teaches an apparatus for dry etching a substrate (Figure 1), comprising: a plasma reactor 15 for containing a plasma; a mechanical support 16 isolated from the creation of the plasma (Figure 1); and an additional structure 30 capable of being electrically biased (Column 5, Lines 57-58), the additional structure disposed within the plasma reactor proximal to the mechanical support (Figure 1), at least a portion of the additional structure extending into the plasma at a time when the plasma reactor contains the plasma (Column 3, Lines 9-12).

In regards to Claims 1, 2, and 4, Hayashi et al. teaches that the additional structure 30 is dc electrically biased (Column 5, Lines 57-58). *Hayashi et al. teaches that the dc electrical bias is provided by a pair of positive and negative variable bias power sources 34. (Figure 1; Column 5, Line 57 - Column 6, Line 5)*

Hayashi et al. does not expressly teach a pulse waveform power source adapted to electrically bias the additional structure to direct electrons from the plasma towards the substrate, or that the additional structure can be both ac and dc electrically biased.

Lee teaches that an additional structure 60 can be ac electrically biased by a *variable* pulse waveform power source 64 that alternately attracts negatively and

Art Unit: 1763

positively charged particles towards the substrate. (Column 6, Line 50 - Column 7, Line 25)

It would have been obvious to one of ordinary skill in the art to modify the additional structure taught by Hayashi et al. to be both ac and dc electrically biased by adding a variable pulse waveform power source connected to the additional structure, as taught by Lee. The motivation for doing so, as taught by Lee (Column 6, Line 50 - Column 7, Line 25), would have been to generate a pulsed charged-particle beam with a desired base voltage.

The Examiner notes that the structure of Hayashi et al. includes a *positive variable* dc electrical bias power source coupled to the additional structure. This positive dc electrical bias power source would provide a positive base line for the ac pulse waveform power source provided by Lee, and the combination of the positive variable dc electrical bias and the ac pulse waveform would be structurally capable of directing electrons from the plasma towards the substrate. During the positive swing of the pulse waveform power source, negative particles, including electrons, would be directed to the substrate to perform etching, while during the negative swing of the pulse waveform power source, positive particles would be directed to the substrate. See Lee, Column 6, Line 50 - Column 7, Line 25. Since both the positive dc electrical bias power source taught by Hayashi et al. and the ac pulse waveform power source taught by Lee are *variable* power sources, the combination of the two power sources would be structurally capable of being set at sufficient voltage so as to provide sufficient energy for the electrons to etch material from the substrate.

While the combination of Hayashi et al. and Lee does not expressly state that the apparatus is used for *low-damage anisotropic electron dry etching*, *the apparatus taught by the combination of Hayashi et al. and Lee is structurally the same as the claimed apparatus*, and would be structurally capable of performing low-damage anisotropic electron dry etching.

It has been held that claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function (*In re Danly*, 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959)), and that a claim containing a "recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus" if the prior art apparatus teaches all the structural limitations of the claim (*Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987)).

In regards to Claim 5, Hayashi et al. teaches that the mechanical support is electrically isolated from the plasma creator by insulation 17. (Column 5, Lines 4-8)

In regards to Claim 6, Hayashi et al. teaches that the additional structure is electrically isolated from the mechanical support and the plasma creator by electrically insulating member 32. (Figure 1; Column 5, Lines 51-56)

In regards to Claims 7 and 9, see the discussion of Claims 2 and 4 above.

In regards to Claims 10 and 11, the apparatus taught by Hayashi et al. includes an electrically insulating member 32 disposed on and circumscribing a portion of the mechanical support, and in communication with the additional structure. (Figure 1; Column 5, Lines 51-56)

Art Unit: 1763

In regards to Claims 23-25, the pulse waveform taught by the combination of Hayashi et al. and Lee cycles between a positive and negative potential to direct particles of alternating charge to the substrate. This pulse waveform would be capable of directing enough ions of one charge towards the substrate to neutralize an existing charge on the substrate, without damaging the substrate, based on the voltage and timing settings of the bias power sources.

Moreover, as discussed above, the voltage supplied to the additional structure by the combination of the positive dc bias power source of Hayashi et al. and the pulse waveform power source of Lee is variable. The apparatus of Hayashi et al. and Lee would be structurally capable of providing a positive potential such that electrons with kinetic energy less than 100 electron-volts reach the substrate to perform etching, based on the voltage settings of the power sources. Again, it has been held that claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function (*In re Danly*, 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959)), and that a claim containing a "recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus" if the prior art apparatus teaches all the structural limitations of the claim (*Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987)).

Claims 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hayashi et al. in view of U.S. Patent 6,231,777 to Kofuji et al. (from Applicant's IDS)

The Examiner notes in regards to Claim 16 and its dependent Claims 17-22 and 26, that it appears that Applicant has invoked the provisions of 35 U.S.C. 112, 6th Paragraph. The "means plus function" language of the claims has been interpreted in accordance with the written description in the Specification. Specifically, the "plasma creation means" recited in Lines 4-5 of Claim 16 has been interpreted as referring to any of the art-recognized equivalent plasma generating structures disclosed by Applicant (i.e. capacitive, inductive, microwave, etc.; Specification, Paragraph 51). The "electron etcher means" recited in Lines 8-10 of Claim 16 has been interpreted as referring to the pulse waveform power source connected to the substrate holder. (Specification, Paragraphs 58-59) The "charged particle controller means" recited in Lines 11-14 of Claim 16 has been interpreted as referring only to the additional structure 14 (Figure 3), not to the pulse waveform power source adapted to bias the additional structure (Specification, Paragraph 60), since the pulse waveform power source adapted to bias the "charged particle controller means" is explicitly recited in Claim 19.

In regards to Claim 16, Hayashi et al. teaches an apparatus for dry etching a substrate (Figure 1), comprising: a plasma reactor 15; a plasma creation means (microwaves, waveguide 12, and gas from inlet 14) at least partially disposed within the plasma reactor (the microwaves and gas enter the reactor) for creating a plasma having positively charged ions and electrons (Column 3, Lines 3-8); a substrate holder 16 disposed within the plasma reactor for receiving a substrate 33, wherein the holder is isolated from the creation of the plasma in chamber 11 (Figure 1); and a charged

Art Unit: 1763

particle controller means (additional structure 30), the charged particle controller means disposed proximal to the substrate holder (Figure 1).

Hayashi et al. further teaches that the substrate holder 16 is dc electrically biased (Column 5, Lines 11-13). *Hayashi et al. teaches that the dc electrical bias is provided by a pair of positive and negative variable bias power sources 21. (Figure 1; Column 5, Lines 11-19)*

Hayashi et al. does not expressly teach an etcher means (pulsed electrical bias power source) in electrical communication with the substrate holder.

Kofuji et al. teaches that an etcher means (pulsed electrical bias power source) is in electrical communication with a substrate holder. (Column 11, Lines 24-38) Kofuji expressly teaches that electrons are drawn to the substrate during the positive swing of the pulsed electrical bias. (ex. Column 2, Lines 29-52)

It would have been obvious to one of ordinary skill in the art to modify the apparatus taught by Hayashi et al. to include an etcher means (pulsed electrical bias power source in electrical communication with the substrate holder. The motivation for doing so, as taught by Kofuji et al. (Column 11, Lines 34-38), would have been to avoid notching and charge build-up on the substrate during etching.

The Examiner notes that the structure of Hayashi et al. includes a *positive variable* dc electrical bias power source coupled to the substrate holder. This positive dc electrical bias power source would provide a positive base line for the ac pulse waveform power source provided by Kofuji et al., and the combination of the positive variable dc electrical bias and the ac pulse waveform would be structurally capable of

Art Unit: 1763

directing electrons from the plasma towards the substrate. During the positive swing of the pulse waveform power source, negative particles, including electrons, would be directed to the substrate to perform etching, while during the negative swing of the pulse waveform power source, positive particles would be directed to the substrate. Again, Kofuji et al. expressly teaches that electrons are drawn to the substrate during the positive swing of the pulsed electrical bias. (ex. Column 2, Lines 29-52) Since the positive dc electrical bias power source taught by Hayashi et al. is a *variable* power source, the combination of the two power sources of Hayashi et al. and Kofuji et al. would be structurally capable of being set at sufficient voltage so as to provide sufficient energy for the electrons to etch material from the substrate.

While the combination of Hayashi et al. and Kofuji et al. does not expressly state that the apparatus is used for *low-damage anisotropic electron dry etching*, *the apparatus taught by the combination of Hayashi et al. and Kofuji et al. is structurally the same as the claimed apparatus*, and would be structurally capable of performing low-damage anisotropic electron dry etching.

The Examiner also notes that the claims do not exclude additional etching performed by other (i.e. positive or neutral) particles, and indeed require that positive particles are drawn to the substrate during the negative swing of the electrical bias to neutralize the charge build-up on the substrate, just as taught by Kofuji et al. (ex. Column 2, Lines 29-52) This rejection is based on the fact the apparatus structure taught above has the inherent capability of being used in the manner intended by the

Art Unit: 1763

Applicant. When a rejection is based on inherency, a rejection under 35 U.S.C. 102 or U.S.C. 103 is appropriate. (See *In re Fitzgerald* 205 USPQ 594 or MPEP 2112).

Additionally, Hayashi et al. teaches that the charged particle controller means (additional structure 30) is dc electrically biased (Column 5, Lines 57-58). *Hayashi et al. teaches that the dc electrical bias is provided by a pair of positive and negative variable bias power sources 34. (Figure 1; Column 5, Line 57 - Column 6, Line 5)* The positive variable dc electrical bias power source would be structurally capable of controlling the flux of charged particles from a plasma passing through it to a substrate 33 disposed on the substrate holder 16 (See Column 2, Lines 60 - Column 3, Line 26), and causing the flux to have sufficient energy for the electrons to etch material from the substrate, based on the voltage settings of the positive variable dc electrical bias power source.

It has been held that claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function (*In re Danly*, 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959)), and that a claim containing a "recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus" if the prior art apparatus teaches all the structural limitations of the claim (*Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987)).

In regards to Claim 17, the charged particle controller means (additional structure 30) taught by Hayashi et al. is controllably electrically biased by positive and negative variable electrical bias power sources 34 (Column 4, Lines 11-20; Column 5, Lines 57-58), which would be structurally capable of controlling the energy of charged particles

Art Unit: 1763

being impacted on the substrate, based on the voltage settings for the variable dc power source.

It has been held that claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function (*In re Danly*, 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959)), and that a claim containing a "recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus" if the prior art apparatus teaches all the structural limitations of the claim (*Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987)).

In regards to Claim 18, Hayashi et al. teaches a charged particle blocking means (insulating member 32; Figure 1). This insulating member would be structurally capable of preventing charged particles in the plasma from reaching the substrate unless the charged particles pass through the charged particle controller means, due to its position and insulative properties.

It has been held that claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function (*In re Danly*, 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959)), and that a claim containing a "recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus" if the prior art apparatus teaches all the structural limitations of the claim (*Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987)).

Art Unit: 1763

Claims 19-22 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hayashi et al. in view of Kofuji et al. as applied to claim 16 above, and further in view of Lee et al.

The teachings of Hayashi et al. and Kofuji et al. were discussed above.

Hayashi et al. teaches that the additional structure 30 is dc electrically biased (Column 5, Lines 57-58). *Hayashi et al. teaches that the dc electrical bias is provided by a pair of positive and negative variable bias power sources 34. (Figure 1; Column 5, Line 57 - Column 6, Line 5)*

The combination of Hayashi et al. and Kofuji et al. does not expressly teach a pulse waveform power source adapted to electrically bias the charged particle controller means (additional structure) to direct electrons from the plasma towards the substrate.

Lee teaches that an additional structure 60 can be ac electrically biased by a *variable* pulse waveform power source 64 that alternately attracts negatively and positively charged particles towards the substrate. (Column 6, Line 50 - Column 7, Line 25)

It would have been obvious to one of ordinary skill in the art to modify the additional structure taught by Hayashi et al. and Kofuji et al. to be both ac and dc electrically biased by adding a variable pulse waveform power source connected to the additional structure, as taught by Lee. The motivation for doing so, as taught by Lee (Column 6, Line 50 - Column 7, Line 25), would have been to generate a pulsed charged-particle beam with a desired base voltage.

The Examiner notes that the structure of Hayashi et al. includes a *positive variable* dc electrical bias power source coupled to the additional structure. This positive dc electrical bias power source would provide a positive base line for the ac pulse waveform power source provided by Lee, and the combination of the positive variable dc electrical bias and the ac pulse waveform would be structurally capable of directing electrons from the plasma towards the substrate. During the positive swing of the pulse waveform power source, negative particles, including electrons, would be directed to the substrate to perform etching, while during the negative swing of the pulse waveform power source, positive particles would be directed to the substrate. See Lee, Column 6, Line 50 - Column 7, Line 25. Since both the positive dc electrical bias power source taught by Hayashi et al. and the ac pulse waveform power source taught by Lee are *variable* power sources, the combination of the two power sources would be structurally capable of being set at sufficient voltage so as to provide sufficient energy for the electrons to etch material from the substrate.

It has been held that claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function (*In re Danly*, 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959)), and that a claim containing a "recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus" if the prior art apparatus teaches all the structural limitations of the claim (*Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987)).

In regards to Claims 20-22 and 26, the pulse waveform taught by the combination of Hayashi et al. and Lee as supplied to the additional structure cycles between a positive and negative potential to direct particles of alternating charge to the substrate. This pulse waveform would be capable of directing enough ions of one charge towards the substrate to neutralize an existing charge on the substrate, without damaging the substrate, based on the voltage and timing settings of the bias power sources.

Moreover, as discussed above, the voltage supplied to the additional structure by the combination of the positive dc bias power source of Hayashi et al. and the pulse waveform power source of Lee is variable. The apparatus of Hayashi et al. and Lee would be structurally capable of providing a positive potential such that electrons with kinetic energy less than 100 electron-volts reach the substrate to perform etching, based on the voltage settings of the power sources. Again, it has been held that claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function (*In re Danly*, 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959)), and that a claim containing a "recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus" if the prior art apparatus teaches all the structural limitations of the claim (*Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987)).

Art Unit: 1763

Claims 1, 2, 4-7, 9-11, and 23-25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation "the creation of the plasma" in Line 5. There is insufficient antecedent basis for this limitation in the claim, since the claim does not recite any sort of plasma creation means. Claims 2, 4-7, 9-11, and 23-25 are rejected due to their dependence on Claim 1.

(10) Response to Argument

In regards to Applicant's arguments against the §103 rejections of Claims 1, 2, 4-7, 9-11, and 16-26, the Examiner responds that the rejection over the cited references is not based on the *structural capability* of the apparatus taught by the combination of Hayashi et al. with Lee and/or Kofuji et al. to perform the recited *intended use of low-damage anisotropic electron dry etching*, including the recited intended use of the pulse waveform power sources coupled to the mechanical support and/or the additional structure in order to direct electrons from the plasma to the substrate with sufficient energy to etch material from the substrate. As discussed above, a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. The Examiner notes that the functional limitations of the claims have not been disregarded, as asserted by Applicant, but rather have been fully considered, and determined to *not* result in a structural difference between

Art Unit: 1763

the claimed invention and the cited prior art. The Examiner maintains that a proper standard for patentability has been applied. As a specific example, the *positive* dc electrical bias power sources taught by Hayashi et al., and the fact that these power sources are of *variable voltage*, and thus capable of performing the intended use *recited in the claims* of being “adapted” (i.e. set to a particular voltage) to provide a desired amount of energy to the electrons in the plasma, that makes the apparatus taught by the combination of Hayashi et al. with Lee and/or Kofuji et al. structurally capable of biasing the substrate holder and the additional structure so as to direct electrons to the substrate with sufficient energy to etch material from the substrate. The Examiner’s position in this regard is fully set forth in the rejection above. The Examiner has provided a technical basis for asserting that the structure of the apparatus taught by the combination of the cited references would be structurally capable of performing the functional limitations recited in the claims (not, as asserted by Applicant, that the apparatus must be somehow further modified to perform the functional limitations recited in the claims).

In response to Applicant’s argument that the claimed invention is for “electron dry etching” and “electron enhanced etching,” while each of Hayashi et al., Lee, and Kofuji et al. is concerned with ion etching, and that the teachings of Lee are not applicable, since Lee teaches that electrons are confined in the plasma rather than used to etch the substrate, the Examiner argues that the apparatus taught by the cited combinations of Hayashi et al., Lee, and Kofuji et al. meets the structural limitations of the claimed invention and would be structurally capable of performing the intended use of electron

etching, based on the technical reasoning set forth above. The Examiner argues that the fact that Applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

The Examiner particularly notes in regards to point (1) set forth by Applicant on Page 9 of the Appeal Brief (and similar assertions elsewhere in the Appeal Brief), that the statement in the Office Action that the power sources of the apparatus taught by the cited combination of references are capable of being "adapted to provide a desired amount of energy to the electrons in the plasma" does not mean that the apparatus taught by the cited combination of references must be somehow further modified to meet the claims. Rather, the *positive* dc electrical bias power sources taught by Hayashi et al., and the fact that these power sources are of *variable voltage*, and thus capable of performing the intended use *recited in the claims* of being "adapted" (i.e. set to a particular voltage) to provide a desired amount of energy to the electrons in the plasma, makes the apparatus taught by the combination of Hayashi et al. with Lee and/or Kofuji et al. structurally capable of biasing the substrate holder and the additional structure so as to direct electrons to the substrate with sufficient energy to etch material from the substrate. The use of the word "adapted" was due to the Examiner quoting the claim language in the body of the rejection to ensure that every limitation of the claims was treated on the merits -- not to indicate that the apparatus taught by the cited combination of references must be somehow further modified to meet the claims.

Art Unit: 1763

Similarly, in regards to points (2) and (3) set forth by Applicant on Page 9 of the Appeal Brief (and similar assertions elsewhere in the Appeal Brief), it is because the cited power sources are of *variable voltage* that the Examiner argues that they are structurally capable of being set at any desired or particular voltage so as to provide a desired amount of energy to the electrons in the plasma.

In regards to the rejection of Claims 1, 2, 4-7, 9-11, and 23-25 under 35 U.S.C. 112, second paragraph, the Examiner maintains that Claim 1 has insufficient antecedent basis for the recitation of "the creation of the plasma" in Line 5. Certainly the plasma must somehow be created in order to be provided to the plasma reactor. However, one of ordinary skill in the art would be unable to determine the metes and bounds of the claims, since it is unclear whether the claim includes a means for creating a plasma (and if so, what means that might be).

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

Art Unit: 1763

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Maureen G. Arancibia/

Maureen G. Arancibia

Art Unit 1763

Conferees:

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